

Application No.: 09/759,257

Docket No.: 20402-00620-US

REMARKS

The Office Action and prior art relied upon have been carefully considered. Copies of Figs 4 and 5 with the legend "Prior Art" accompanies this amendment as required in the Office Action. Similarly, the title has been changed as required.

The Examiner rejects claims 1 and 2 under 35 U.S.C. 103(a) as being unpatentable over Ikeda et al. (U.S. Patent 6,204,881) and further in view of Kawai et al. (U.S. Patent 6,141,047).

The Examiner rejects claim 3 under 35 U.S.C. 103(a) as being unpatentable over Ikeda et al. in view of Kawai et al. and further in view of Kamishima et al. (U.S. Patent Application Publication 2001/0001245).

In an effort to expedite the prosecution claims 1-3 have been amended to clarify the patentable aspects of the invention. In addition claims 4-7 have been added and they are likewise believed to be distinguishable over the prior art.

Prior to commenting upon the rejection, a brief overview of the invention should be helpful to the Examiner.

An object of the present invention is to improve the image quality of a video signal and also improve the dynamic range performance. Providing the capability of independently setting the gain and the knee point for each of the long-term exposure signal and the short-term exposure signal enables the solid state imaging apparatus to improve the gradation of a mixing portion of the mixed signal. Improvement of the dynamic range performance essentially requires a system for smoothly mixing exposure signals without worsening the gradation at a mixing portion.

As shown in Fig. 5, according to a fundamental prior art solid state imaging apparatus shown in Fig. 4, a mixing level of two exposure signals is equalized to a 100% level at a final video output. The knee point is a fixed value in the vicinity of 100% level.

Application No.: 09/759,257

Docket No.: 20402-00620-US

On the other hand, characteristic setting of the knee point according to the present invention is different from the above fundamental prior art example as clearly shown in Fig. 2.

According to a preferred embodiment of the present invention, the knee point of the long-term exposure signal is reduced from an ordinary 100% level to a 80% level only when an image picked-up object requires a dynamic range. A mixing level is maintained at the same 100% or to the vicinity thereof. Therefore, the long-term exposure signal has the mixing point at a brightness level subjected to compression by the knee processing. The smoothness of a mixed signal is doubled compared with the above-described fundamental one. The short-term exposure signal dedicated average brightness detecting section 16 detects an average brightness value of the short-term exposure signal. The microcomputer 10 inputs the detected average brightness value of the short-term exposure signal. An algorithm stored in the microcomputer 10 judges that an image picked-up object requires a dynamic range when the average brightness value of the short-term exposure signal is large. Thus, the microcomputer 10 performs a control for reducing the knee point of the long-term exposure signal. Next, for the short-term exposure signal, its gain is fixed to a doubled level.

Meanwhile, solely shortening the exposure time of the short-term exposure signal for the purpose of improving the dynamic range may result in losing the improved effects of the dynamic range, when the gain for the short-term exposure signal is fixed to the doubled value. To eliminate this drawback, the present invention sets the knee point for the short-term exposure signal to a point higher than the mixing level of the long-term exposure signal and the short-term exposure signal.

In other words, the knee point for the short-term exposure signal is fixed to a level exceeding 100% at the final video output. This is substantially equal to applying the polygonal line gamma processing to the short-term exposure signal, as shown in Fig. 2. Thus, the smoothness of the mixed signal is doubled without losing the improved effects of the dynamic range.

Application No.: 09/759,257

Docket No.: 20402-00620-US

In rejecting claim 1, the Examiner states that Ikeda et al. (U.S. Patent 6,204,881) discloses a solid state imaging apparatus comprising an image pickup means (401) for alternately outputting two kinds of video signals within a period of field.

However, with respect to the image sensing devices 401a and 401b of Ikeda et al. it is not clear if these sensing devices 401a and 401b output the long-term exposure signal and the short-term exposure signal alternately or sequentially in one horizontal scanning period as shown in Fig. 3 of this invention.

Furthermore, the Examiner states that Ikeda et al. discloses a setting means for independently setting a gain and a knee point for each of the long-term exposure signal and the short-term exposure signal, by referring to the description in col. 20, lines 17-40; col. 26, lines 48-65; col. 27, lines 24-27; col. 28, lines 6-8 and 11-19 as well as the disclosure of Figs. 23, 24 and 33. However, there is no description concerning the changing of the knee point for each of the long-term exposure signal and the short-term exposure signal.

For supporting the deficiency of the main reference Ikeda et al., the Examiner further cites Kawai et al. (U.S. Patent 6,141,047). According to the Examiner, Kawai et al. discloses a solid state imaging apparatus comprising a setting means for independently setting a gain and a knee point for each of the long-term exposure signal and the short-term exposure signal, the Examiner referring to the description in col. 4, lines 50-62 and col. 7, lines 5-15 as well as the disclosure of Fig. 2.

However, as is apparent from Fig. 2, the knee circuit 8 of Kawai et al. is located as a post-processing means for receiving a signal processed in AGC 4, A/D 5, image memory 6, and γ -correction circuit 7. In this respect, it is unclear if the knee circuit 8 of Kawai et al. can perform the function of the presently claimed setting means. Namely, it is unclear if a knee point of the short-term exposure signal is set to a level higher than the mixing level before the long-term exposure signal and the short-term exposure signal are mixed in a mixing means.

Application No.: 09/759,257

Docket No.: 20402-00620-US

Furthermore, according to the description on col. 4, lines 50-62, Kawai et al. changes the knee characteristics by changing the inclination of the knee characteristics, not the level of knee point.

In this respect, the knee circuit 8 of Kawai et al. does not adjust a knee point of the short-term exposure signal to a level higher than the mixing level of the long-term exposure signal and the short-term exposure signal.

From the foregoing, it is respectfully submitted that the present invention defined in amended independent claim 1 cannot be obtained by combining Ikeda et al. (U.S. Patent 6,204,881) and Kawai et al. (U.S. Patent 6,141,047).

Amended dependent claim 2 emphasizes the characteristic setting of a knee point of the short-term exposure signal. Newly added dependent claim 5 recites the remaining features relating to the gain adjustment of the original claim 2.

Amended dependent claim 3 now states that the recited average brightness value detecting means judges if an image picked-up object requires a dynamic range. This limitation further differentiates the invention from the cited references.

A new independent claim 6 is added to define the characteristic features of the present invention from a different perspective while dependent claims 4 and 7 further emphasize the feature of the present invention, wherein setting means sets the knee point of the long-term exposure signal.

Application No.: 09/759,257

Docket No.: 20402-00620-US

For the reasons set forth above all the claims are believed to be allowable.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 22-0185, under Order No. 20402-00620-US from which the undersigned is authorized to draw.

Dated: July 21, 2004

Respectfully submitted,

By 
Morris Liss

Registration No.: 24,510

CONNOLLY BOVE LODGE & HUTZ LLP

1990 M Street, N.W., Suite 800

Washington, DC 20036-3425

(202) 331-7111

(202) 293-6229 (Fax)

Attorney for Applicant